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(54) **Flat gaskets**

(57) To avoid flange fractures of edgings 2 around the combustion chamber openings of a gasket 1, the outer faces 5, 6 of the edgings are provided over their entire area or partially with friction-reducing coatings 4, 7 of e.g. fluoropolymer on one or both sides of the gasket. The remaining surface areas 8 which are left free of this coating may have a friction-increasing coating e.g. of elastomer. The friction-reducing coating may be covered by a further coating which improves the micro-sealing action. The friction-increasing coating may be an adhesive coating which extends over the outer faces of the edgings and serves to bond the friction-reducing coating to them.

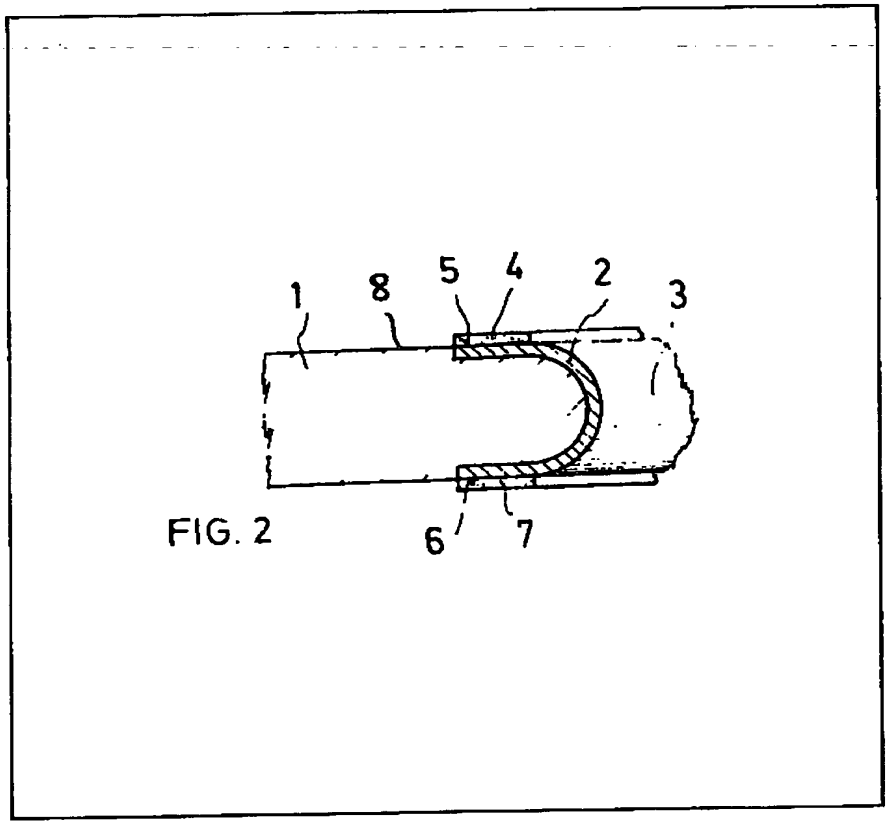

FIG. 2

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This print embodies corrections made under Section 117(1) of the Patents Act 1977.

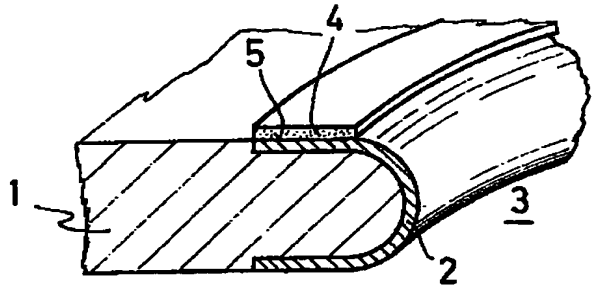

FIG. 1

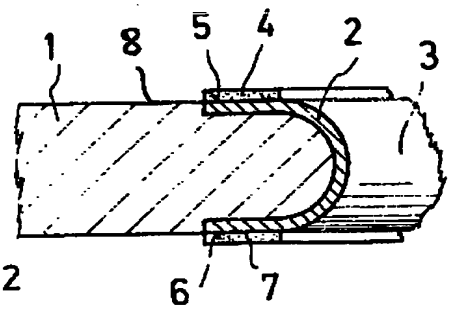

FIG. 2

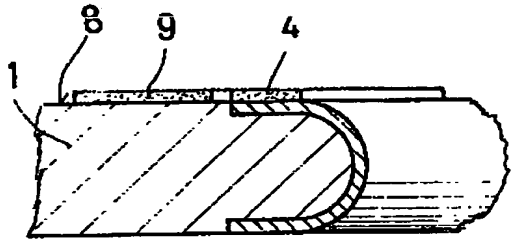

FIG. 3

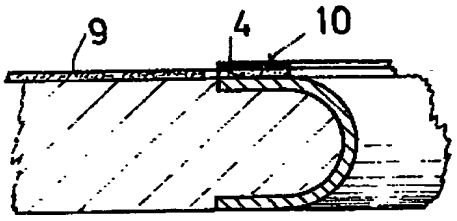

FIG. 4

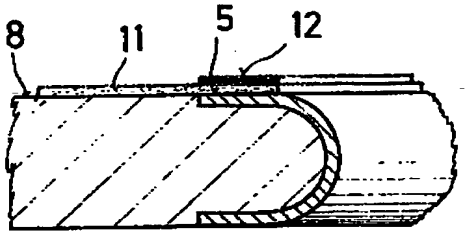

FIG. 5

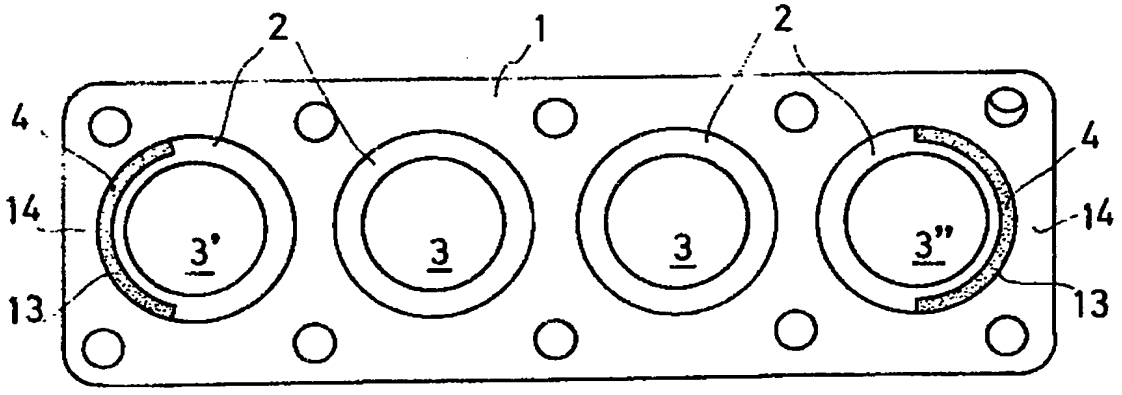

FIG. 6

SPECIFICATION

Flat gasket, in particular a cylinder head gasket

The invention relates to a flat gasket, in particular a cylinder head gasket of impregnated asbestos fibre nonwoven, having at least one reinforcement, preferably for the combustion chamber opening, consisting of an edging bent over the rim thereof so that it is substantially U-shaped in cross-section.

Cylinder head gaskets for internal combustion engines preferably consist of sheet steel plates or if necessary metal-reinforced and impregnated asbestos fibre nonwovens. They have through openings for the combustion chambers, the coolant, the lubricant and the clamping bolts. In order to increase the sealing pressure and the applied sealing pressure, the areas around the combustion chamber openings, in particular, and if necessary the areas around the liquid openings are covered with edgings, generally of metal, bent over the rim of the opening so that they are U-shaped in cross-section. If necessary, to increase the micro and macrosealing action and for special proctection against the media, the outer faces of the flanges may be provided with plastics coatings over their entire area.

During engine operation, in addition to the static loading of cylinder head gaskets in an axial direction, they are also subjected to stress in a radial direction due to shifting movements of the engine block and cylinder head. As described in the Reinz house publication "Informationen aus der Dichtungstechnik" (Information on Sealing Technique", Issue 10, 1975, page 32, these shifting movements are chiefly caused by the varying thermal expansion and contraction of the engine block and cylinder head during the varying heating up and cooling down of the engine in the working state. In particular in the case of engines with cylinder heads of aluminium and engine blocks of cast iron, because of the different degrees of thermal expansion of the two metals, relative movements of the two parts are brought about and between them the intermediate cylinder head gasket is gradually ground away and then leaks.

The edging sheets of cylinder head gaskets are also subjected to stresses. In fact, fractures of the flanges are produced above all in the region of the bends at the cut faces of the openings and, starting from these fractures, the entire edging is destroyed. According, for example, to German Patent Specification 16 50 026, the opinion has been held heretofore that solely vibrations between the engine block and the cylinder head in an axial direction subject the bend of the edging to bending stresses and produce the fractures thereat. Attempts have therefore been made to give the flanges particular b nding strength by means of inserts consisting of spring rings and/or by a special configuration of the region of the bend. Flang fractures are not, however, avoided completely in this way.

In order t avoid wear of the sealing surfaces of cylinder head gaskets as a result of shifting movements of the engine block and cylinder head, it i known from U.S. Patent Specification 4,103,913 to provide the sealing surfaces of metal gaskets without edgings to the openings with friction-reducing coatings over their entire area which are based on fluoropolymers with additions of molybdenum disulphide. Due to the sliding friction reduced thereby, the transfer of force to the sealing surfaces is prevented and, consequently, the described desruction of the gasket. Of course, with such gaskets, the amplitude of the shifting movement of the engine block and cylinder head gasket is substantially increased by reason of the lubricating coating. The more pronounced movements reduce the micro and macrosealing action of the gasket, in particular with respect to the hot combustion gases.

Therefore, the problem underlying the invention is to provide a cylinder head gasket with edgings in particular at combustion chamber openings for use preferably in internal combustion engines with aluminium cylinder heads and cast iron engine blocks, the edgings being substantially protected against fractures and their micro and macrosealing action being ensured. At the same time, it is to be possible to produce the gasket simply and at a saving in cost.

According to the invention, this problem is solved by means of a cylinder head gasket in which the outer faces of the sides of the edgings are provided with a coating reducing the sliding friction on the side towards the cylinder head and/or towards the engine block. The remaining surface areas are free from any coating of this kind. Such coatings are preferably the lubricating coatings known *per se* consisting of polytetrafluoroethylene or the commercial lubricating lacquers with or without additions of solid lubricating substances such as molybdenum disulphide, graphite or boron nitride. The thickness of the coating depends on the application and is preferably between 0.1 and 0.001 mm.

If necessary, the lubricating coating may at the same time cover an adjacent zone of the gasket or sealing plate beyond the sides of the flange, also in particular in the case of liner-type engines.

The gasket according to the invention has been tested in engines with aluminium cylinder heads and cast iron engine blocks, wherein in order to simulate extreme shifting movements the cylinder head was heated and cooled in short cycles, and has been compared with the values of conventional gaskets without a lubricating coating and with gaskets having lubricating coatings over their entire area. Surprisingly, it was found that no flange fractures occurred in the gasket according to the invention, whereas flange fractures were repeatedly observed in the conventional gasket. In comparison with the gasket coated over its entire area, the shifting amplitudes measured had distinctly decreased. The macro and microsealing action of the gasket according to the invention was good and was in the range of tolerable limits.

In fact, contrary to the assumption made in German Patent Specification 16 50 026, the vibrating movement of the cylinder head and engine block does n t appear to be exclusively responsible for flange fracture, but more important ar obviously the shifting movements of the two parts. Indeed, in conventional uncoated edgings, a pronounced trans-

fer of force to the edging through friction obviously takes place, s that with relative movem nts the flanges are distorted towards the side where the more markedly expanding cylinder head is located and in the process are subjected to stress in the region of the bends with the formation of cracks. The lubricating coating according to the invention on the outer flange faces reduces the friction and thereby a transfer of force which leads to fracture. The lubricating coating absent according to the invention from the remaining areas checks the shifting movement of the cylinder head and engine block down to a minimum. Compared with a gasket covered over its entire area with a lubricating coating, the gasket has an adequate micro and macrosealing action.

Since the invention is in any case preferably applied to cylinder head gaskets impregnated in accordance with German Laid-open Patent Specification 23 04 559, whose soft material has a high strength, the increased friction canot cause destruction thereof. It has even been found that the remaining surface areas may be coated with special coatings increasing the friction and having a restraining or adhering effect, such as coatings of elastomers, special synthetic resins or water glass with or without additions of friction-increasing solids such as quartz or corundum powder, in order to increase the restraining effect. If necessary, the lubricating and/or restraining coatings are covered in addition with coatings improving the microsealing action.

Since, moreover, the shifting movement between the cylinder head and the engine block is greater in the outer zones than in the inner zones of the gasket and, consequently, the edgings are stressed to varying degress, it is sufficient if the edgings are provided only partially with a lubricating coating. In gaskets for multi-cylinder engines, preferably only the faces of the flange sides of the outer openings are partially coated at the end surfaces of the gaskets.

While the coating according to the invention is used chiefly in cylinder head gaskets of soft material or metal, the invention can also by used in other gaskets loaded by a shifting movement. In a motor vehicle, these are exhaust flange gaskets or oil sump gaskets.

The invention is described in detail with reference to the drawings and, in fact, Figures 1 to 5 are cross-sections through cylinder head gaskets in the region of a combustion chamber. Figure 6 is a plan view of a partially coated cylinder head gasket.

In the drawings, 1 designates the plate of the cylinder head gasket with the edging 2 bent into a U-shape over the rim of the combustion chamber opening 3.

In Figure 1, the upper outer face 5 of the side of the edging in contact with the cylinder head is provided with a lubricating coating 4 of fluoropolymer.

In Figure 2, both outer side faces 5, 6 of the edging 2 are provided with a lubricating coating 4, 7.

In Figure 3, th remaining surface area 8 of the gasket 1 facing th cylinder head is provided in addition with a coating 9 restraining or checking any sliding action.

Figure 4 corresponds to the embodiment of Figure 3, the lubricating coating 4 of which is provided in addition with a coating 10 improving the microsealing action.

In Figure 5, the upper sealing surface of the gasket 1 is provided with an adhesive coating 11 over its entire area. The upper side 5 of the edging is covered in addition with a lubricating coating 12, so that the adhesive coating 11 improves the adhesion of the lubricating coating 12 and restrains the sliding movements in the remaining surface area 8.

In Figure 6, 1 is the cylinder head gasket in plan view with four combustion chamber openings 3 disposed side by side and each of which is provided with an edging 2. The edgings 2 at the two outer combustion chamber openings 3' and 3", which are most heavily loaded by a shifting movement, are partially provided with a lubricating coating 4 in the sectors 13 at the outer end surfaces 14 of the gasket 1.

CLAIMS

1. A flat gasket having an opening with a reinforcement consisting of an edging bent over the rim of the opening so that it is substantially U-shaped in cross-section, wherein the outer face of the edging on at least one side of the gasket is provided with a coating to reduce sliding friction while the remaining surface areas of the gasket are left substantially free of any such coating.

2. A gasket as claimed in claim 1 in which the coating consists of fluoropolymer or of lubricating lacquer, with or without additions of solid lubricants such as graphite, molybdenum disulphide or boron nitride.

3. A gasket as claimed in claim 1 or 2 in which the coating has a thickness of 0.01 to 0.1 mm.

4. A gasket as claimed in any of claims 1 to 3 in which the remaining surface areas on one or both sides of the gasket are provided with a coating which increases the sliding friction.

5. A gasket as claimed in any of the preceding claims having a further coating to improve the microsealing action applied over the friction-reducing coating and/or the friction-increasing coating.

6. A gasket as claimed in any of the preceding claims in the form of a cylinder head gasket of impregnated non-woven asbestos fibre material with the edging provided around a combustion chamber opening.

7. A gasket as claimed in any of the preceding claims in which the friction-reducing coating extends only over the parts of the outer face of the edging which are subject to the greatest shifting movements.

8. A gasket as claimed in claim 6 for a multi-cylinder in-line engine wherein only the edgings of the two outer combustion chamber openings have friction-reducing coatings and in each case the coating is nly on a part of th edging remote from the ther combustion chamber openings.

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